FORM PTO-1390 (Modified) (REV 11-2000) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER: **112701-331**

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR): **10/030567**

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/EP00/06612	**06 July 2000**	**08 July 1999**

TITLE OF INVENTION

EXTRUSION DIE PLATE AND CUTTER ASSEMBLY WITH HYDRAULIC MOTOR

APPLICANT(S) FOR DO/EO/US

Farnsworth et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (24) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☐ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☐ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2)).
   a. ☐ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☒ A copy of the International Search Report (PCT/ISA/210).

Items 13 to 20 below concern document(s) or information included:

13. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
20. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
21. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
22. ☒ Certificate of Mailing by Express Mail
23. ☒ Other items or information:

Express Mail No.: EL 727 381 315 US
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U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
10/050567	PCT/EP00/06612	112701-331

24. The following fees are submitted:.		CALCULATIONS PTO USE ONLY	
BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :			
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO	**$1040.00**		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO	**$890.00**		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	**$740.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4)	**$710.00**		
☐ International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4)	**$100.00**		
ENTER APPROPRIATE BASIC FEE AMOUNT =		**$890.00**	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		**$0.00**	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	20 - 20 =	0	x $18.00	**$0.00**	
Independent claims	6 - 3 =	3	x $84.00	**$252.00**	
Multiple Dependent Claims **(check if applicable).**			☐	**$0.00**	
TOTAL OF ABOVE CALCULATIONS =				**$1,142.00**	
☐ Applicant claims small entity status. See 37 CFR 1.27). The fees indicated above are reduced by 1/2.				**$0.00**	
SUBTOTAL =				**$1,142.00**	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)). +				**$0.00**	
TOTAL NATIONAL FEE =				**$1,142.00**	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).** ☐				**$0.00**	
TOTAL FEES ENCLOSED =				**$1,142.00**	
				Amount to be: refunded	$
				charged	$

a. ☒ A check in the amount of **$1,142.00** to cover the above fees is enclosed.

b. ☐ Please charge my Deposit Account No. _____ in the amount of _____ to cover the above fees. A duplicate copy of this sheet is enclosed.

c. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

d. ☐ Fees are to be charged to a credit card. **WARNING:** Information on this form may become public. **Credit card information should not be included on this form.** Provide credit card information and authorization on PTO-2038.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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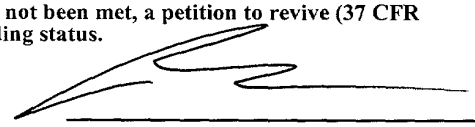

SIGNATURE

Robert M. Barrett
NAME

30,142
REGISTRATION NUMBER

January 7, 2002
DATE

Substitute Form PTO 07 JAN 2002

10/030567

CERTIFICATE OF MAILING BY "EXPRESS MAIL" (37 CFR 1.10) Applicant(s): **Farnsworth et al.**			Docket No. **112701-331**
Serial No. **Unknown**	Filing Date **Herewith**	Examiner **Unknown**	Group Art Unit **Unknown**

Invention:

EXTRUSION DIE PLATE AND CUTTER ASSEMBLY WITH HYDRAULIC MOTOR

I hereby certify that the following correspondence:

Transmittal Letter (duplicate); International Application as filed; Unexecuted Declaration and Power of Attorney; International Preliminary Examination Report; International Search Report; Preliminary Amendment; Return Receipt Postcard; and Check in the Amount of $1,142.00 (filing fee).

(Identify type of correspondence)

is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 in an envelope addressed to: The Assistant Commissioner for Patents, Washington, D.C. 20231 on

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Farnsworth et al.
Appl. No.: PCT/EP00/06612
Filed: Filed Herewith
Title: EXTRUSION DIE PLATE AND CUTTER ASSEMBLY WITH HYDRAULIC MOTOR
Art Unit: Unknown
Examiner: Unknown
Docket No.: 112701-331

Commissioner for Patents
Washington, DC 20231

PRELIMINARY AMENDMENT

Sir:

Please amend the above-identified patent application as follows:

In the Claims:

Please amend Claims 1-4, 6-11 and 13-15 as follows:

1. A die plate for an extrusion apparatus, the die plate comprising:

first coupling means for coupling the die plate on a first side thereof to an extruder defining a longitudinal axis, and

apertures, through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by a cutter assembly disposable on said longitudinal axis, the cutter assembly having a fluid driven motor for rotating a cutter transversely to said longitudinal axis into the path of movement of extrudate so as to sever the extrudate in use,

the die plate having

second coupling means for coupling the die plate on a second side thereof to said cutter assembly,

a fluid inlet passage for receiving fluid into the die plate for delivery to said cutter assembly in use, and

a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate.

2. A die plate according to Claim 1 having a peripheral edge adjoining said first and second sides, the fluid inlet passage and fluid outlet passage each having a radial portion extending radially through said peripheral edge toward a central area of the die plate where each passage terminates in a respective longitudinal portion extending through said second side of the die plate.

3. A die plate according to Claim 1 wherein said first and second coupling means comprise a plurality of mounting openings for receiving respective fasteners through the die plate.

4. A die plate according to Claim 1 including thermal insulation means between the fluid inlet and outlet passages and the extrudate apertures.

6. An assembly comprising a die plate, a cutter assembly and a fluid-driven motor,

the die plate having first coupling means for coupling the die plate on a first side thereof to an extruder that defines a longitudinal axis, and including apertures through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by said cutter assembly,

the cutter assembly being disposed on said longitudinal axis and comprising a rotatable cutter driven for rotation transversely to said longitudinal axis by said motor into the path of movement of extrudate, so as to sever the extrudate,

the assembly including

second coupling means for coupling the die plate on a second side thereof to the cutter assembly,

the die plate includes a fluid inlet passage for receiving fluid for delivery to said cutter assembly and a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate, and

the fluid-driven motor is coupled to said second side of the die plate and is adapted to receive motor-driving fluid from said fluid inlet passage and to discharge said fluid into said fluid outlet passage.

7. An assembly according to Claim 6 in which the rotatable cutter includes a housing coupled for rotation to said motor, the motor being received within said housing.

8. An assembly according to Claim 6 wherein the housing includes blade mounting means for supporting at least one radially extending blade having a predetermined separation from said second side of the die plate and adapted to sever extrudate emerging therefrom in use.

9. An assembly according to Claim 6 wherein the first and second coupling means comprise respective oppositely directed counter-sunk openings.

10. An assembly according to Claim 6 wherein the motor is a hydraulic motor.

11. An assembly according to Claim 6 wherein the die plate includes thermal insulation means between the fluid inlet and outlet passages and the extrudate apertures.

13. An assembly according to Claim 12 wherein the gap is gas-filled.

14. A cutter assembly for cutting extrudate comprising positioning means for positioning the cutter assembly close to an extrudate outlet, a housing, a fluid-driven motor receivable to be mountable in the housing, a cutting blade that, on actuation of the motor in use, is caused to rotate into a path of movement of extrudate emerging from the said extrudate outlet, so as to sever it, and including mounting means for mounting the blade to the housing.

15. A cutter assembly according to Claim 14 wherein the positioning means comprises coupling means for coupling the assembly to a die plate so that the blade is located to be a predetermined distance from the plate.

Please add newly-submitted Claims 17-20 as follows:

17. A die plate for use in an extrusion apparatus, the die plate comprising:

a first coupling member for coupling the die plate on a first side thereof to an extruder defining a longitudinal axis,

apertures, through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by a cutter assembly disposable on said longitudinal axis that rotates a cutter transversely to the longitudinal axis so as to sever the extrudate,

a second coupling member for coupling the die plate on a second side thereof to said cutter assembly,

a fluid inlet passage for receiving fluid into the die plate for delivery to said cutter assembly in use, and

a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate.

18. A die plate according to Claim 17 wherein said first and second coupling means comprise a plurality of mounting openings for receiving respective fasteners through the die plate.

19. An assembly comprising:

a die plate having a first coupling member for coupling the die plate on a first side thereof to an extruder that defines a longitudinal axis, and including apertures through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by said cutter assembly,

a cutter assembly that is located on said longitudinal axis and comprising a rotatable cutter that rotates transversely to said longitudinal axis into the path of movement of extrudate, and a second coupling member for coupling the die plate on a second side thereof to the cutter assembly,

a die plate including a fluid inlet passage for receiving fluid for delivery to said cutter assembly and a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate, and

the fluid-driven motor is coupled to said second side of the die plate and is adapted to receive motor-driving fluid from said fluid inlet passage and to discharge said fluid into said fluid outlet passage.

20. A cutter assembly for cutting extrudate comprising a positioning member for positioning the cutter assembly close to an extrudate outlet, a housing, a fluid-driven motor, a cutting blade that can be caused to rotate into a path of movement of extrudate emerging from the said extrudate outlet, so as to sever it, and a mounting member for mounting the blade to the housing.

REMARKS

This Preliminary Amendment is submitted in the above-identified patent application. Pursuant to the Preliminary Amendment, Claims 1-4, 6-11 and 13-15 have been amended and newly-submitted Claims 17-20 have been added. This Preliminary Amendment does not add new matter.

Applicants also note for the record that this Preliminary Amendment is being made to place the claims in proper U.S. format and/or to add new claims. Accordingly, Applicants are not making the Preliminary Amendment for purposes of narrowing the claims and therefore do not intend to disclaim any subject matter in view of this Preliminary Amendment.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "**Versions with Markings to Show Changes Made.**"

Respectfully submitted,

BELL, BOYD & LLOYD LLC

BY _____

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

Please amend Claims 1-4, 6-11 and 13-15 as follows:

1. (Amended) A die plate for an extrusion apparatus, the die plate [(42) having] comprising:

first coupling means for coupling the die plate [(42)] on a first side thereof to an extruder defining a longitudinal axis, and

apertures [(44)], through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by a cutter assembly disposable on said longitudinal axis, the cutter assembly [being of a type] having a fluid driven motor for rotating a cutter transversely to said longitudinal axis into the path of movement of extrudate so as to sever the extrudate in use,

the die plate [being characterised by] having

second coupling means [(54)] for coupling the die plate on a second side thereof to said cutter assembly,

a fluid inlet passage [(56)] for receiving fluid into the die plate for delivery to said cutter assembly in use, and

a fluid outlet passage [(60)] for receiving fluid from said cutter assembly for discharge from the die plate [(42)].

2. (Amended) A die plate according to Claim 1 having a peripheral edge [(92)] adjoining said first and second sides, the fluid inlet passage [(56)] and fluid outlet passage [(60)] each having a radial portion extending radially through said peripheral edge toward a central area [(88)] of the die plate where each passage terminates in a respective longitudinal portion extending through said second side of the die plate.

3. (Amended) A die plate according to Claim 1 [or claim 2] wherein said first and second coupling means comprise a plurality of mounting openings [(80, 90)] for receiving respective fasteners [(82, 54)] through the die plate.

4. (Amended) A die plate according to Claim 1 [any one of the preceding claims having] including thermal insulation means between the fluid inlet and outlet passages and the extrudate apertures.

6. (Amended) An assembly comprising a die plate [(42)], a cutter assembly [(46)] and a fluid-driven motor [(52)],

the die plate [(42)] having first coupling means for coupling the die plate on a first side thereof to an extruder [(40)] that defines a longitudinal axis, and including apertures [(44, 86)] through which extrudate is received from the extruder [(40)] and extruded for cutting into predetermined lengths by said cutter assembly [(46)],

the cutter assembly [(46)] being disposed on said longitudinal axis and comprising a rotatable cutter driven for rotation transversely to said longitudinal axis by said motor into the path of movement of extrudate, so as to sever the extrudate,

the assembly [being characterised in having] including

second coupling means [(54, 90)] for coupling the die plate on a second side thereof to the cutter assembly [(46)], and [in that]

the die plate includes a fluid inlet passage [(56)] for receiving fluid for delivery to said cutter assembly [(46)] and a fluid outlet passage [(60)] for receiving fluid from said cutter assembly for discharge from the die plate [(42)], and [in that]

the fluid-driven motor is coupled to said second side of the die plate and is adapted to receive motor-driving fluid from said fluid inlet passage [(56)] and to discharge said fluid into said fluid outlet passage [(60)].

7. (Amended) An assembly according to Claim 6 in which the rotatable cutter includes a housing [(46)] coupled for rotation to said motor, the motor being received within said housing.

8. (Amended) An assembly according to Claim 6 [or 7 in which] wherein the housing includes blade mounting means for supporting at least one radially extending blade [(48)] having a predetermined separation from said second side of the die plate and adapted to sever extrudate emerging therefrom in use.

9. (Amended) An assembly according to [any one of claims] Claim 6 [to 8 in which] wherein the first and second coupling means comprise respective oppositely directed counter-sunk openings [(80, 90)].

10. (Amended) An assembly according to [any one of claims] Claim 6 [to 9 in which] wherein the motor [(52)] is a hydraulic motor.

11. (Amended) An assembly according to [any one of claims] Claim 6 [to 9 in which] wherein the die plate includes thermal insulation means between the fluid inlet and outlet passages and the extrudate apertures.

13. (Amended) An assembly according to Claim 12 [in which] wherein the gap is gas-filled.

14. (Amended) A cutter assembly [(46)] for cutting extrudate comprising positioning means for positioning the cutter assembly close to an extrudate outlet, a housing [(47)], a fluid-driven motor [(52)] receivable to be mountable in the housing, a cutting blade [(48)] that, on actuation of the motor [(52)] in use, is caused to rotate into a path of movement of extrudate emerging from the said extrudate outlet, so as to sever it, [characterised by having] and including mounting means for mounting the blade to the housing [(47)].

15. (Amended) A cutter assembly according to Claim 14 wherein the positioning means comprises coupling means for coupling the assembly to a die plate so that the blade [(48)] is located to be a predetermined distance from the plate.

Please add newly-submitted Claims 17-20 as follows:

17. A die plate for use in an extrusion apparatus, the die plate comprising:

a first coupling member for coupling the die plate on a first side thereof to an extruder defining a longitudinal axis,

apertures, through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by a cutter assembly disposable on said longitudinal axis that rotates a cutter transversely to the longitudinal axis so as to sever the extrudate,

a second coupling member for coupling the die plate on a second side thereof to said cutter assembly,

a fluid inlet passage for receiving fluid into the die plate for delivery to said cutter assembly in use, and

a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate.

18. A die plate according to Claim 17 wherein said first and second coupling means comprise a plurality of mounting openings for receiving respective fasteners through the die plate.

19. An assembly comprising:

a die plate having a first coupling member for coupling the die plate on a first side thereof to an extruder that defines a longitudinal axis, and including apertures through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by said cutter assembly,

a cutter assembly that is located on said longitudinal axis and comprising a rotatable cutter that rotates transversely to said longitudinal axis into the path of movement of extrudate, and a second coupling member for coupling the die plate on a second side thereof to the cutter assembly,

a die plate including a fluid inlet passage for receiving fluid for delivery to said cutter assembly and a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate, and

the fluid-driven motor is coupled to said second side of the die plate and is adapted to receive motor-driving fluid from said fluid inlet passage and to discharge said fluid into said fluid outlet passage.

20. A cutter assembly for cutting extrudate comprising a positioning member for positioning the cutter assembly close to an extrudate outlet, a housing, a fluid-driven motor, a cutting blade that can be caused to rotate into a path of movement of extrudate emerging from the said extrudate outlet, so as to sever it, and a mounting member for mounting the blade to the housing.

EXTRUSION DIE PLATE AND CUTTER ASSEMBLY WITH HYDRAULIC MOTOR

FIELD OF THE INVENTION

This invention relates to extrusion apparatus which includes a die plate through which extrudate is received and shaped, the extrudate being severed into discrete pieces as it emerges from the die plate by a cutter assembly having a blade that is rotated into the path of movement of the extrudate.

BACKGROUND OF THE INVENTION

Cutter assemblies for cutting extrudate have in the past been associated with electrically-driven motors. Such a cutter assembly will rotate about a fixed shaft mounted to the extruder and the coupling to a motor for rotation may be via a spool attached to a belt driven by the motor, as in US 5,641,529, or via a universal drive connection that is itself coupled to another drive. Such assemblies are cumbersome because of the space occupied by the electric motor, the associated coupling means, and the framework necessary to support the motor unit.

US patent number 5,525,052 describes an extrusion machine enabling the changing of extrusion dies without incurring production down time, by providing at least two dies on a support plate that is rotatable on an axis parallel with respect to the extruder axis. An hydraulic motor may be used to power a cutter that is arranged to sever extrudate leaving the extruder through the die. There is no mention of the arrangement for supplying drive fluid to and removing it from the motor. A drive shaft connects the motor to a satellite mitre gear that is coupled to provide drive to the cutter.

An object of this invention is to provide means for rotating a cutter blade that may be integrated into the cutter assembly to thereby save space and facilitate maintenance of the extrusion apparatus.

SUMMARY OF THE INVENTION

In accordance with a first aspect of this invention, a die plate for an extruder is modified to be coupled directly to a fluid-driven motor on one side and to an extruder on the other side. Suitable fluid inlet and outlet passages are formed in the die plate to supply the motor with motor-driving fluid and to withdraw fluid. The die plate thus has:

first coupling means for coupling the die plate on a first side thereof to an extruder defining a longitudinal axis,

second coupling means for coupling the die plate on a second side thereof to a cutter assembly disposed on said longitudinal axis,

apertures through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by said cutter assembly,

a fluid inlet passage for receiving motor-driving fluid into the die plate for delivery to said cutter assembly, and

a fluid outlet passage for receiving fluid from said cutter assembly for discharge from the die plate, the cutter assembly having a fluid driven motor for rotating a cutter transversely to said longitudinal axis into the path of movement of extrudate so as to sever the extrudate.

In a preferred form of the invention, the die plate has a peripheral edge adjoining the first and second sides, the fluid inlet passage and fluid outlet passage each having a radial portion extending radially through said peripheral edge toward a central area of the die plate where each passage terminates in a respective longitudinal portion extending through said second side of the die plate.

The first and second coupling means preferably include a plurality of mounting openings for receiving respective fasteners through the die plate.

According to a second aspect of the invention, a die plate and cutter assembly includes a die plate having first coupling means for coupling the die plate on a first side thereof to an extruder, defining a longitudinal axis, second coupling means for coupling the die plate on a second side thereof to a cutter assembly disposed on said longitudinal axis, apertures through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by said cutter assembly, a fluid inlet passage for receiving fluid into the die plate for delivery to said cutter assembly, and a fluid outlet passage for receiving fluid

from said cutter assembly for discharge from the die plate, the cutter assembly having a fluid-driven motor coupled to said second side of the die plate and adapted to receive motor-driving fluid from said fluid inlet passage in use and to discharge said fluid into said fluid outlet passage, and a rotatable cutter, driven for rotation transversely to said longitudinal axis by said motor, into the path of movement of extrudate so as to sever the extrudate.

The cutter assembly includes a housing which receives the motor within and is coupled for rotation to an output shaft from the motor.

In a preferred form of the invention, the rotatable cutter includes a housing coupled for rotation to said motor, the motor being receivable within said housing. The motor preferably includes an output shaft which may be coupled to the housing.

In a further preferred form of the invention, the housing includes blade mounting means for supporting at least one radially extending blade having a predetermined separation from said second side of the die plate and adapted to sever extrudate emerging therefrom in use.

The motor may be any fluid driven motor. A preferred embodiment is a hydraulic motor. An alternative preferred embodiment is a pneumatic motor.

The fluid inlet and outlet passages in the die plate may be thermally insulated from the extrudate outlet apertures. Insulation may be by means of a gap that may be filled with a gas. The gas may be air. The gap is preferably located around the fluid passages.

The invention extends in a further aspect to a cutter assembly for coupling to a die plate, and for cutting extrudate emerging therefrom, the assembly comprising positioning means for positioning the assembly close to an extrudate outlet, a housing, a fluid-driven motor receivable to be mountable in the housing, a cutting blade and mounting means for mounting the blade to the housing, so that, on actuation of the motor in use, the blade is caused to rotate into a path of movement of extrudate emerging from the said outlet, so as to sever it.

The positioning means may comprise coupling means for coupling the assembly to a die plate so that the blade is located to be a predetermined distance from the plate.

In a preferred form of the invention, the fluid-driven motor includes a fluid inlet directed toward the die plate for receiving driving fluid therefrom in use. The inlet is preferably directed to be located opposite a corresponding outlet in the die plate to which it is mountable.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the invention is described below with reference to the accompanying drawings, in which:

Fig. 1 is a schematic perspective view showing an extruder coupled to an electrically-driven motor;

Fig. 2 is a similar view to Fig. 1 showing an extruder coupled to a hydraulic motor in accordance with the invention;

Fig. 3 is an exploded perspective view showing a housing for the cutter assembly of Fig. 2 spaced from the hydraulic motor;

Fig. 4 is an enlarged view of circled area 4 in Fig. 3;

Fig. 5 is a front plan view of a die plate comprising the invention;

Fig. 6 is a side elevation view of the die plate of Fig. 5; and

Fig. 7 is a back plan view of the die plate of Fig. 5.

Fig. 8 is similar to Fig. 2, showing an extruder coupled to a pneumatic motor in accordance with the invention.

Fig. 9 is a back plan view of die plate comprising the invention.

DESCRIPTION OF PREFERRED EMBODIMENT

An extruder generally indicated by reference numeral 20 in Fig. 1 comprises a longitudinally-extending housing which is coupled at one end to a die plate 22. The die plate 22 has a plurality of die openings 24 through which extrudate is received during operation of the extruder 20. A cutter assembly 26 is rotatably mounted to a shaft (not shown) and

includes a plurality of radially-extending blades 28 which, when rotated, sever the extrudate into discrete pieces 30. An electrically-driven motor 32 with axially-extending driveshaft 34 is coupled to the cutter assembly 26 via a universal drive connection 36 mounted to one end of the cutter assembly 26 remote from the extruder 20. It will be understood that the motor 32 must be supported, for example, with an associated framework, in order to operate the cutter assembly without becoming unbalanced.

In accordance with the invention, the installation and operation of the extrusion apparatus is simplified considerably by integrating a fluid-driven motor into the cutter assembly. Non-limiting embodiments will now be described with reference to the remaining drawings. In Fig. 2 of the drawings, there is shown a conventional extruder 40 which includes a longitudinally-extending housing and is coupled at one end to a die plate 42 made in accordance with the invention. The die plate 42 has a plurality of die apertures 44 for receiving extrudate from the extruder 40, in accordance with normal practice. A cutter assembly 46 is associated with the die plate 42 and includes a plurality of radially-extending blades 48 for cutting the extrudate into discrete pieces 50.

As can be seen more clearly from Fig 3, the cutter assembly 46 includes a cylindrical housing 47 which houses a hydraulically-driven motor 52. The motor 52 is centrally mounted to the die plate 42 with mounting bolts 54 (only one of which is shown in Fig. 3). Alternatively, the motor 52 could be located eccentrically with respect to the die plate 42. A hydraulic fluid inlet passage 56 in fluid communication with a hydraulic fluid supply hose 58 is formed in the die plate 42 and is in fluid communication with the hydraulic motor 52. A hydraulic outlet passage 60 is also formed in the die plate 42 and is in fluid communication with a hydraulic fluid outlet hose 62 so as to withdraw hydraulic fluid from the hydraulic motor 52.

The hydraulic motor 52 has an output shaft 64 which extends longitudinally from the extruder 40 and has a longitudinally-extending key way 66. The output shaft 64 is received through an opening 68 formed in a boss 70 which extends longitudinally from the housing 47 for the cutter assembly 46 at one end opposite from the extruder 40. A second key way 72 is formed in the opening 68 and slidably receives a key 74. The key 74 is located between key ways 66, 72 and set screw 76 received through an aperture 78 formed in the boss 70 bears

upon the key 74 to prevent longitudinal displacement of the key. This arrangement secures the cutter assembly 46 to the output shaft 64 of the hydraulic motor 52 so that, upon actuation of the motor, the blades 48 will rotate to sever the extrudate. It will be understood that there is a pre-determined separation between the cutter blades 48 and the outer surface of the die plate 42.

The die plate 42 is shown in more detail in Figs. 4 through 6. As will be common in the art, the die plate 42 has coupling means for coupling the die plate on an inner side thereof to the extruder 40 and these comprise a series of counter-sunk openings 80 equally spaced around the periphery of the die plate 42 through which mounting bolts 82 (Fig. 3) are received and threaded into cooperating threaded openings (not shown) provided on the extruder 40.

The die plate 42 includes an inner ring 84 which has a series of equally-spaced openings 86 which define respective die nozzles through which extrudate is received and extruded. In a central area 88 of the die plate 42, three counter-sunk openings 90 are formed to receive the mounting bolts 54 that secure the die plate 42 to the hydraulic motor 52 (Fig. 3). It will be noted that counter-sunk openings 80 and 90 are oppositely directed in order to allow the die plate to be coupled to the extruder 40 and to the hydraulic motor 52 on respective sides thereof.

Both the hydraulic inlet passage 56 and hydraulic outlet passage 60 (only one of which is shown in ghost outline in the side elevation view of Fig. 5) comprise a radial portion which extends radially from a peripheral edge 92 of the die plate 42 towards the central area 88 where the passages terminate in respective longitudinally-extending portions that terminate on the front side of the die plate 42 so as to communicate with respective passages provided in the hydraulic motor 52. O-ring seals (not shown) are seatable in the openings defining the hydraulic inlet passage and outlet passage 56, 60.

By integrating the hydraulic motor into the cutter assembly, the extruder installation is considerably simplified with attendant advantages in minimizing space required for installation and ease of maintenance.

Referring to figures 8 and 9, there is illustrated a further embodiment of the invention, in which the die plate 142, connected to extruder 140, is adapted to receive a pneumatically-

driven motor 152. Here, as previously described with regard to the aforegoing embodiment, bolt holes 180 and 190 enable secural of the die plate 142 to the extruder 140 and motor 152 respectively. The motor 152 is housed in cylindrical housing 147, shown withdrawn to expose the said motor. Tubes 158 and 162 feed and withdraw air from the die plate 142 and are connectable to a compressed air supply system (not shown).

Compressed air tubes 158 and 162 connect with internal channels 156 and 160 within the body of the die plate 142. Surrounding each of the channels 156 and 160 is an insulating gap 196, to provide thermal insulation between the tube and the die plate material and extrudate passing through the die. The gap is filled with air, but it will be appreciated that many other gases would be suitable as substitutes.

As in the case of the equivalent liquid delivering tube described above in respect of the hydraulic counterpart, the air delivering passages extend radially to the central region of the die plate 142 and then change direction to be axially directed for coupling to the corresponding fluid ports on the pneumatic motor in central region 188 of the die plate. The die plate includes nozzle formations 186 for extrudate release and a mechanical seal 198 for facilitating fluid-tight coupling to the extruder.

It will be appreciated that several further variations may be made to the above-described preferred embodiment of the invention within the scope of the appended claims. In particular, it will be noted that, while hydraulic and pneumatic motors have been described, any fluid-driven motor may be accommodated into the above-described arrangement. It will also be appreciated that the key way coupling of the output shaft from the hydraulic motor to the cutter assembly may be modified, as required, as will be appreciated by anyone skilled in this art.

Finally, it will also be immediately apparent that the manner of mounting the cutter blades to the cutter assembly may be modified, as required, to suit the intended application and that a single cutting plate may be substituted for a plurality of cutting blades.

CLAIMS

1. A die plate for extrusion apparatus, the die plate (42) having:
first coupling means for coupling the die plate (42) on a first side thereof to an extruder defining a longitudinal axis, and
apertures (44), through which extrudate is received from the extruder and extruded for cutting into predetermined lengths by a cutter assembly disposable on said longitudinal axis, the cutter assembly being of a type having a fluid driven motor for rotating a cutter transversely to said longitudinal axis into the path of movement of extrudate so as to sever the extrudate in use,
the die plate being characterised by having
second coupling means (54) for coupling the die plate on a second side thereof to said cutter assembly,
a fluid inlet passage (56) for receiving fluid into the die plate for delivery to said cutter assembly in use, and
a fluid outlet passage (60) for receiving fluid from said cutter assembly for discharge from the die plate (42).

2. A die plate according to Claim 1 having a peripheral edge (92) adjoining said first and second sides, the fluid inlet passage (56) and fluid outlet passage (60) each having a radial portion extending radially through said peripheral edge toward a central area (88) of the die plate where each passage terminates in a respective longitudinal portion extending through said second side of the die plate.

3. A die plate according to claim 1 or claim 2 wherein said first and second coupling means comprise a plurality of mounting openings (80, 90) for receiving respective fasteners (82, 54) through the die plate.

4. A die plate according to any one of the preceding claims having thermal insulation means between the fluid inlet and outlet passages and the extrudate apertures.

5. A die plate according to claim 4 wherein the thermal insulation means comprises a gap into which a gas may enter.

6. An assembly comprising a die plate (42), a cutter assembly (46) and a fluid-driven motor (52),
the die plate (42) having first coupling means for coupling the die plate on a first side thereof to an extruder (40) that defines a longitudinal axis, and including apertures (44, 86) through which extrudate is received from the extruder (40) and extruded for cutting into predetermined lengths by said cutter assembly (46),
the cutter assembly (46) being disposed on said longitudinal axis and comprising a rotatable cutter driven for rotation transversely to said longitudinal axis by said motor into the path of movement of extrudate, so as to sever the extrudate,
the assembly being characterised in having
second coupling means (54, 90) for coupling the die plate on a second side thereof to the cutter assembly (46), and in that
the die plate includes a fluid inlet passage (56) for receiving fluid for delivery to said cutter assembly (46) and a fluid outlet passage (60) for receiving fluid from said cutter assembly for discharge from the die plate (42), and in that
the fluid-driven motor is coupled to said second side of the die plate and is adapted to receive motor-driving fluid from said fluid inlet passage (56) and to discharge said fluid into said fluid outlet passage (60).

7. An assembly according to claim 6 in which the rotatable cutter includes a housing (47) coupled for rotation to said motor (52), the motor being received within said housing.

8. An assembly according to claim 6 or 7, in which the housing includes blade mounting means for supporting at least one radially extending blade (48) having a predetermined separation from said second side of the die plate and adapted to sever extrudate emerging therefrom in use.

9. An assembly according to any one of claims 6 to 8 in which the first and second coupling means comprise respective oppositely directed counter-sunk openings (80, 90).

10. An assembly according to any one of claims 6 to 9 in which the motor (52) is a hydraulic motor.

11. An assembly according to any one of claims 6 to 9 in which the die plate includes thermal insulation means between the fluid inlet and outlet passages and the extrudate apertures.

12. An assembly according to claim 11 wherein the insulation means comprises a gap.

13. An assembly according to claim 12 in which the gap is gas-filled.

14. A cutter assembly (46) for cutting extrudate comprising positioning means for positioning the assembly close to an extrudate outlet, a housing (47), a fluid-driven motor (52) receivable to be mountable in the housing, a cutting blade (48) that, on actuation of the motor (52) in use, is caused to rotate into a path of movement of extrudate emerging from the said outlet, so as to sever it, characterised by having mounting means for mounting the blade to the housing (47).

15. A cutter assembly according to claim 14 wherein the positioning means comprises coupling means for coupling the assembly to a die plate so that the blade (48) is located to be a predetermined distance from the plate.

16. A cutter assembly according to claim 15 in which the motor includes a fluid inlet directed toward the die plate to receive driving fluid therefrom.

FIG. 1
PRIOR ART

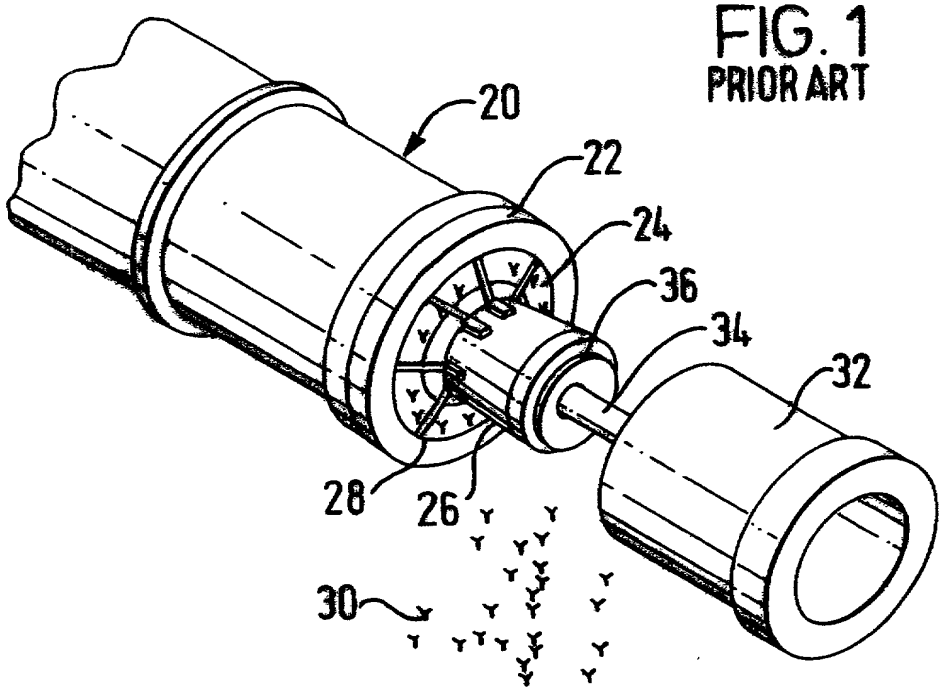
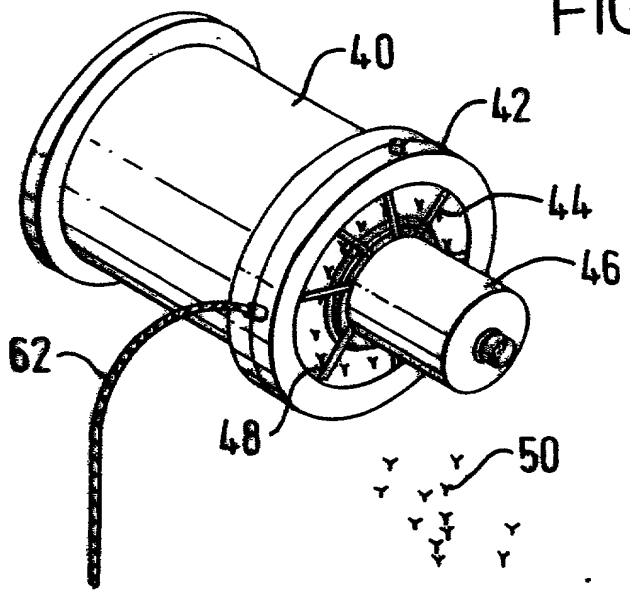


FIG. 2



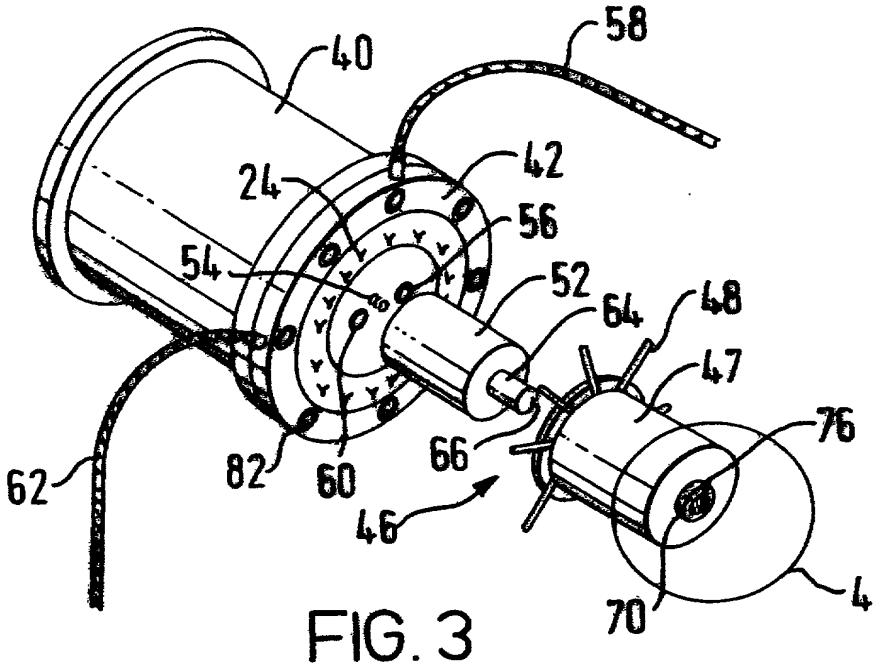

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FIG. 3

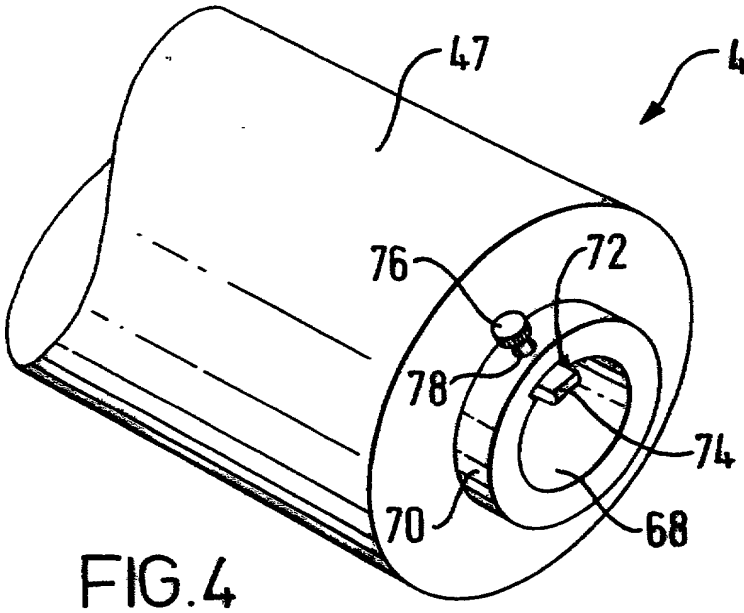
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FIG. 4

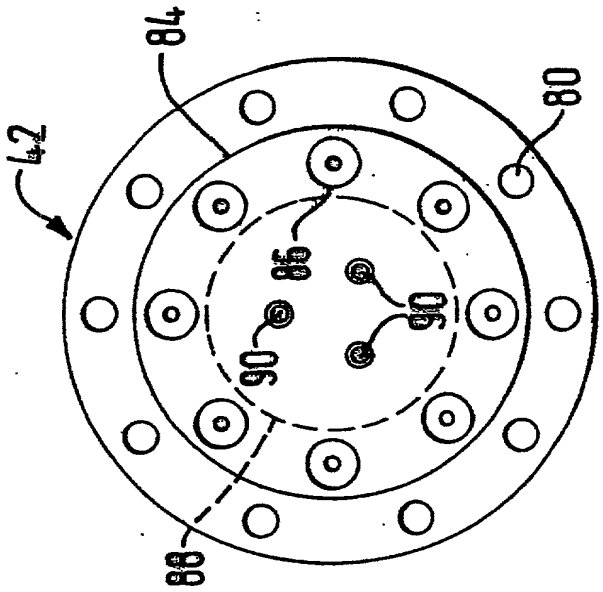

FIG.7

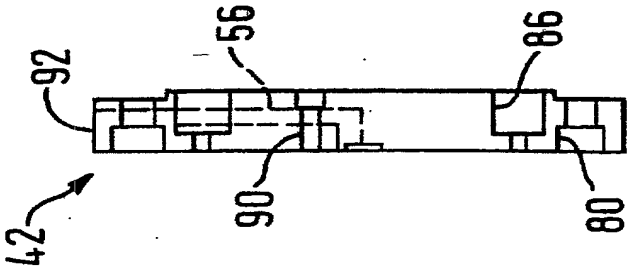

FIG.6

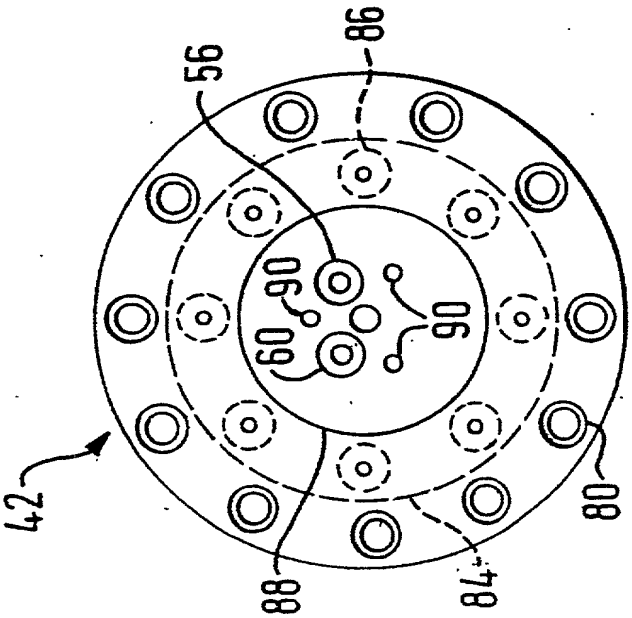

FIG.5

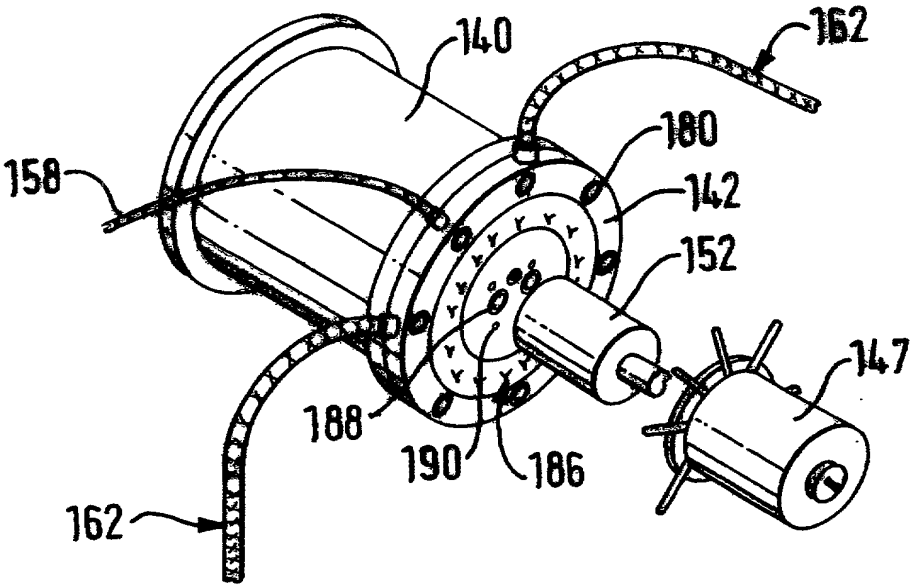
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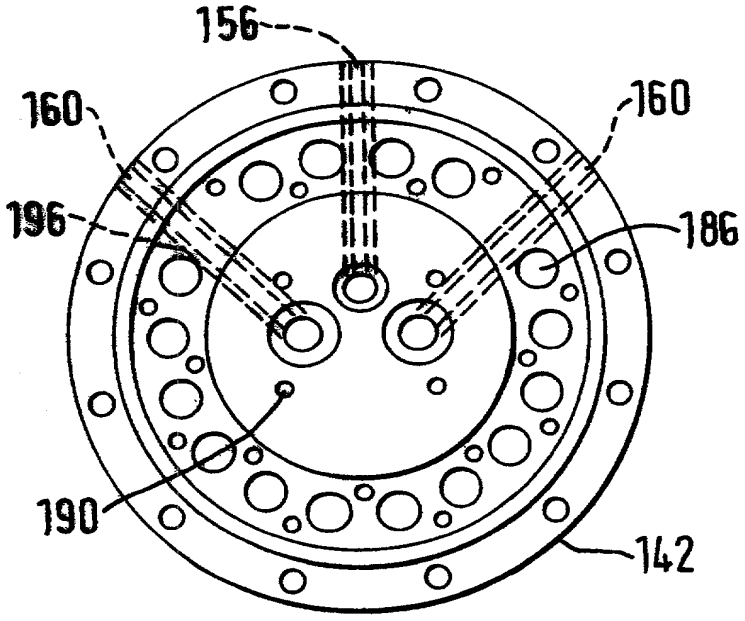
FIG. 8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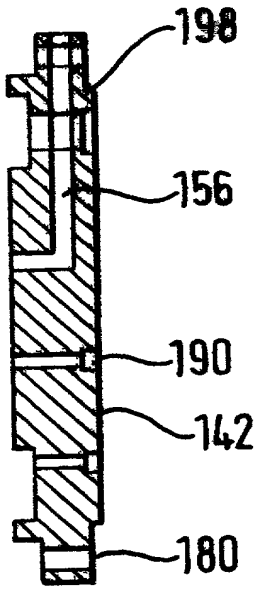
(a)


198
156
190
142
180

(b)

FIG. 9

6506/US/PCT

Docket No. 112701-331 #4

DECLARATION AND POWER OF ATTORNEY FOR PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name,

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

EXTRUSION DIE PLATE AND CUTTER ASSEMBLY WITH HYDRAULIC MOTOR

the specification of which: (check one)

☐ is attached hereto.

☒ was filed on July 6, 2000, as United States Application No. or PCT International Application No. PCT/EP00/06612
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent Office all information which is known to me to be material to the patentability of this application in accordance with Title 37, Code of Federal Regulations, 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code Section 119 or Section 365(b) of any foreign application(s) for patent or inventor's certificate, or Section 365(a) of any PCT international application which designated at least one country other than the United States, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate or PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application(s)

Number	Country	Day/Month/Year Filed	Priority Not Claimed
			☐
			☐
			☐

I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

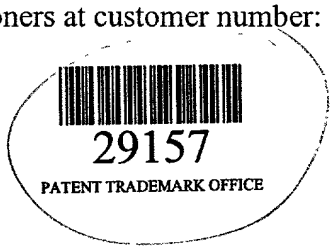
Application Serial No.	**Filing Date**
60/142,827	July 8, 1999

I hereby claim the benefit under 35 U.S.C. Section 120 of any United States application(s), or Section 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in Title 37, C.F.R., Section 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application:

Application Serial No.	**Filing Date**	**Status (patented, pending, abandoned)**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

And I hereby appoint the practitioners at customer number: 29157



as my attorneys with full power of substitution and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith and direct that all correspondence be forwarded to:

Bell, Boyd & Lloyd LLC
P.O. Box 1135
Chicago, Illinois 60690-1135

And all telephone calls be directed to: (312) 807-4204.

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